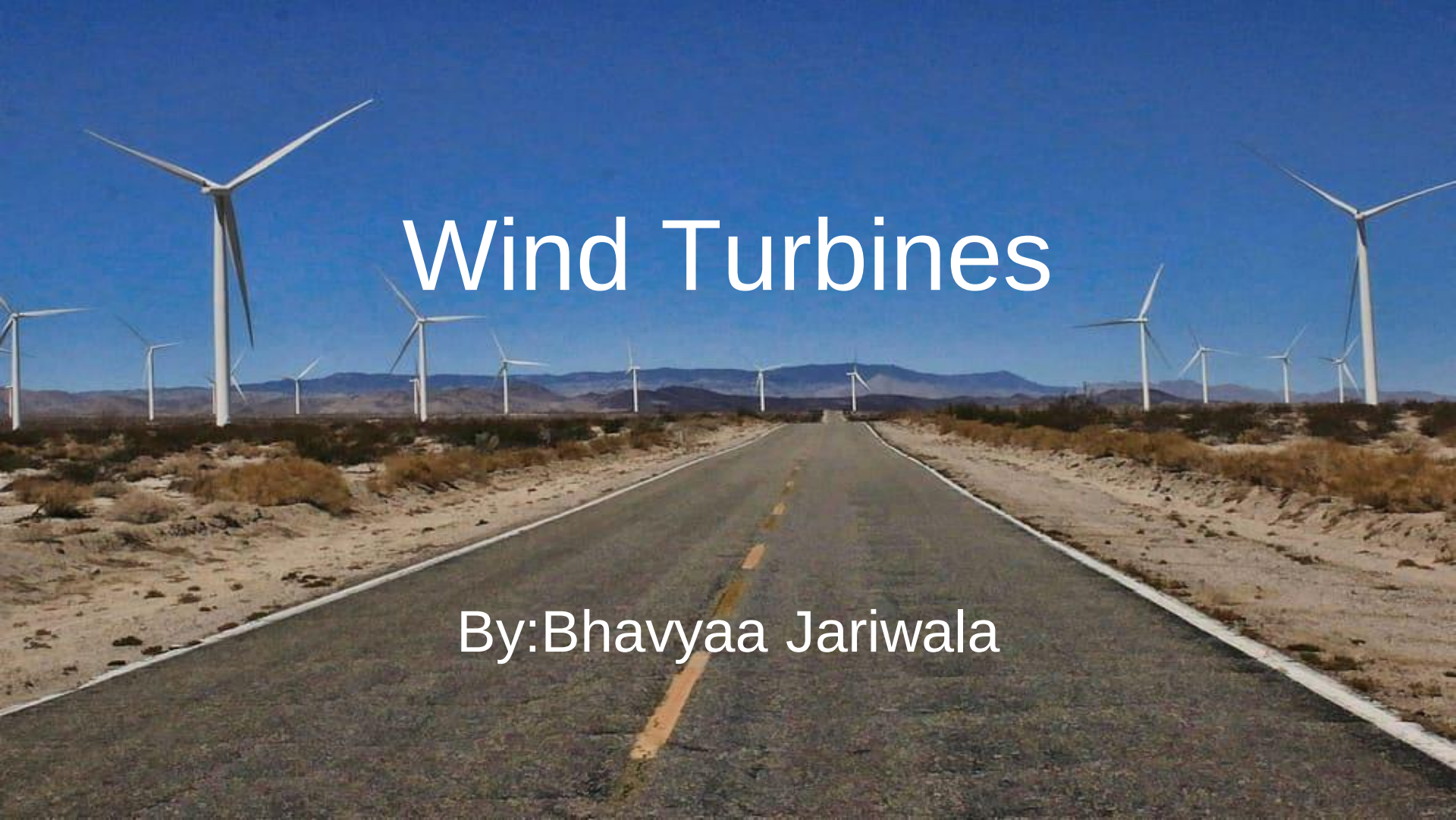


Wind Turbines

By:Bhavyaa Jariwala

How does the wind direction affect the energy produced by a wind turbine?

Changed (Manipulated) Variable: Wind direction with respect to blade rotation

Constant: Blade design, shape, number of blades, wind speed and blade angle

Measured Variable: Power, Voltage and Current Generated

Prediction

I predict that 90^o - 75^o will give me no power and 39^o - 0^o will give me the most amount of power. I think this because 39^o - 0^o is sideways so the wind will be pushing the blades down. I think that from 90^o - 75^o will produce no power because the wind is going against the blades and so the blades will not move at all and no power will be generated.

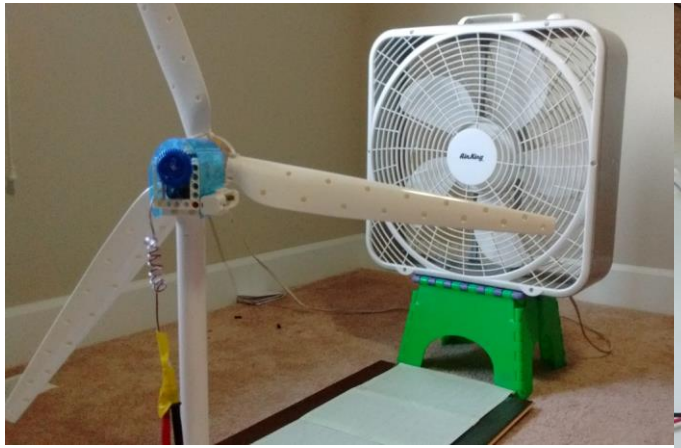
Angle between wind direction and wind turbine	How much power I think will be produced
90^o - 75^o	zero
74^o -60^o	low
59^o - 40^o	medium
39^o - 0^o	high

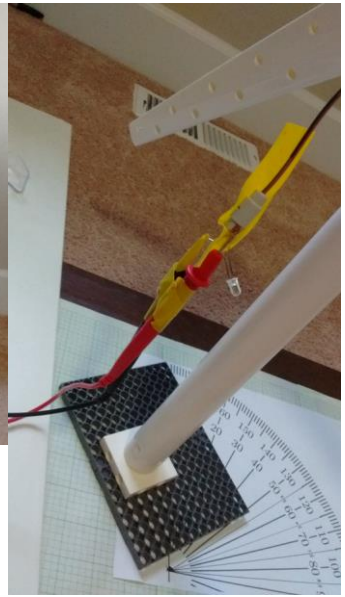
Materials

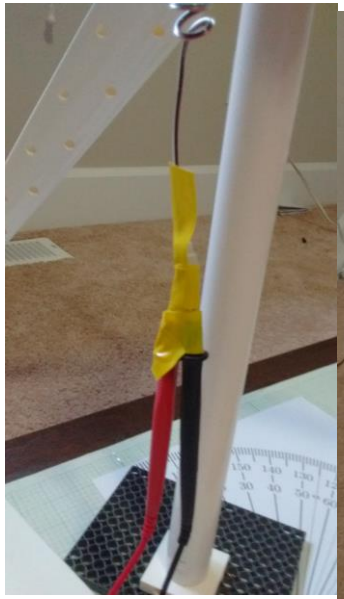
1. Wind Turbine (buy from:http://https//www.amazon.com/Thames-Kosmos-Wind-Power-Science/dp/B00TF8ZE7W)
2. 1 Box Fan as a wind source
3. 1 Multimeter (an instrument designed to measure electric current, voltage, and usually resistance, typically over several ranges of value)
4. 1 Big Protractor print out (use one of these:https://www.digitallycredible.com/free-printable-protractor-180-360-pdf-with-ruler.html)
5. Access to an outlet
6. A stool that is 22 cm tall (or enough height to align the center of the box fan to the center of the wind turbine blade
7. Large ruler to measure the distance between the fan and wind turbine
8. A flat, hard surface to keep all setup aligned
9. Notebook to record data
10. Electrical tape to connect multimeter prongs to the wind turbine motor assembly

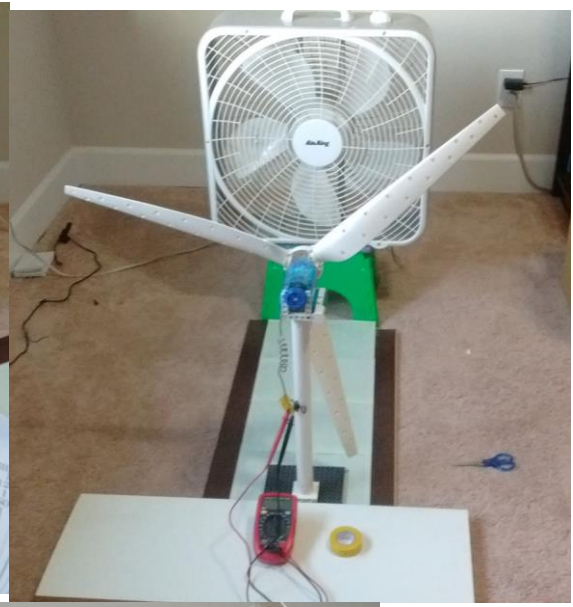
Procedure

1. Gather all materials
2. Assemble wind turbine by following instructions that came with the package. Ensure that all three wind turbine blades are setup with the same angle for consistency. I used setting 1 for our experiment.
3. Connect multimeter to wind turbine and set to measure voltage in Volt.
4. Set a constant fan speed (recommended fan speed:High[3])
5. Set up fan 28 inches away from the wind turbine. Your setup distance may be different. You can find the optimal distance from the fan by starting at 10 inches and measuring the voltage generated after moving turbine an inch away from the fan until the voltage generated reaches a maximum value.
6. Set wind turbine at different angles, for example, 90^0, 85^0, 80^0, and so on per the data table by aligning the base of the wind turbine to the protractor template as a guide.
7. Wait for 30 sec until the voltage reading on multimeter stabilizes.
8. Record voltage - Take at least 3 readings for each angle setting.
9. Change multimeter setting to measure current in milliAmpere. Also, add led light bulb to complete the circuit so that multimeter can measure the current passing through the circuit.
10. Repeat steps 6, 7 and 8.
11. Plot the data on a chart and analyse the data for final conclusion

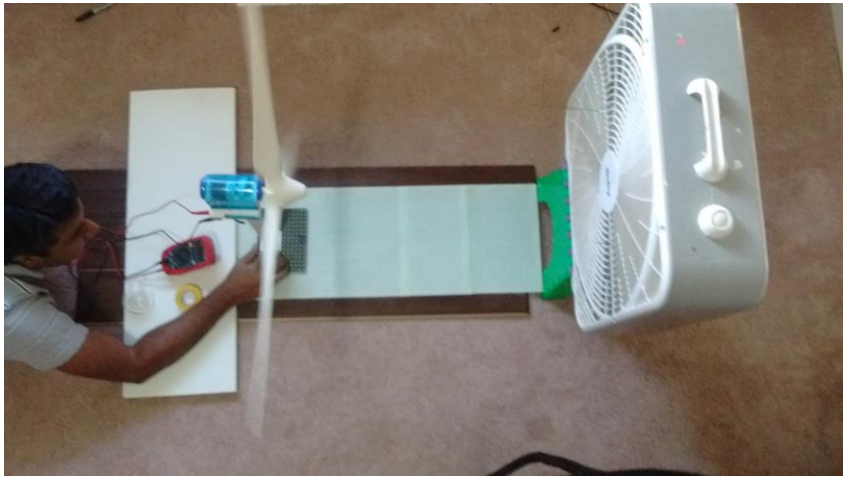


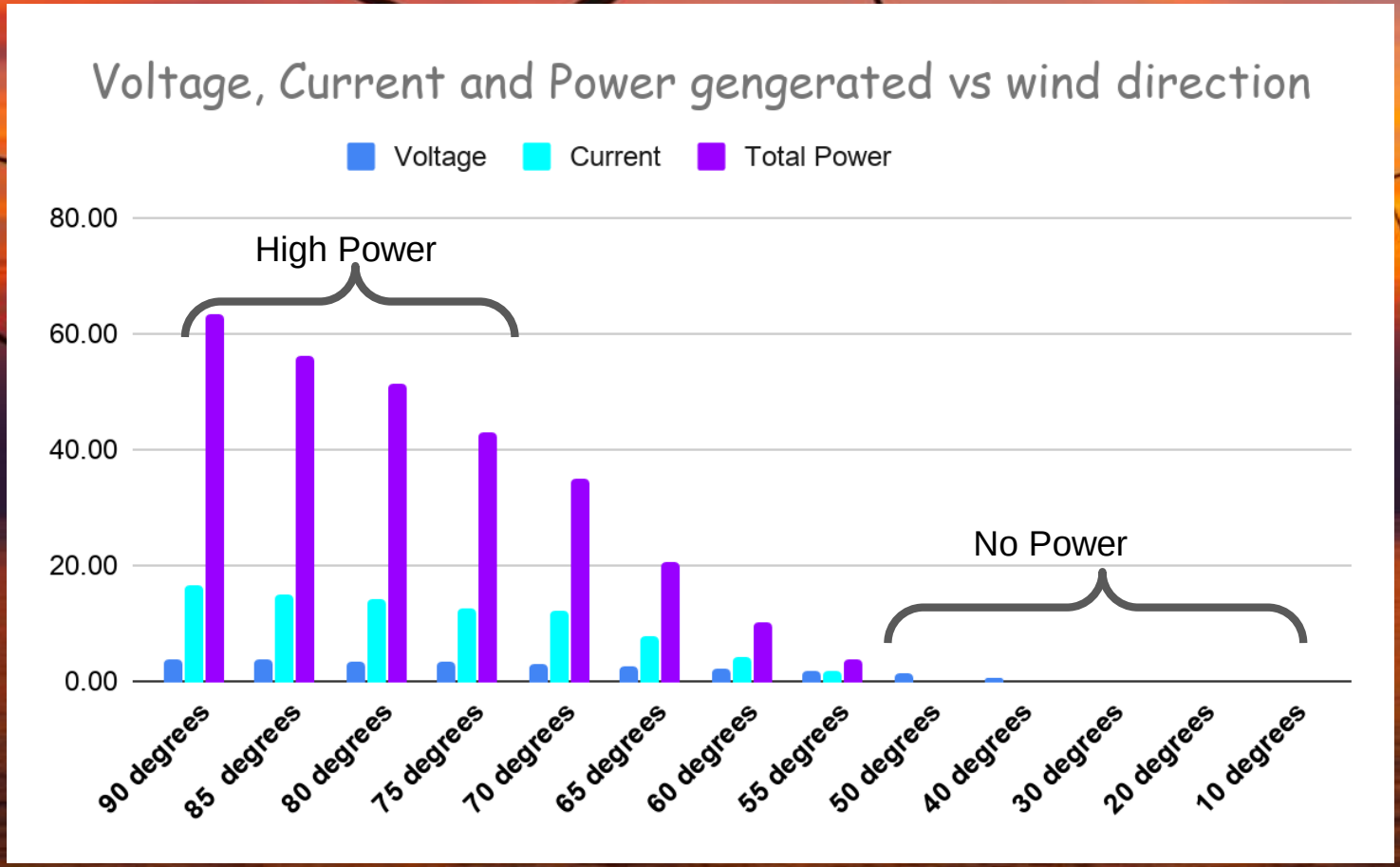






Pictures




Voltage, Current and Power gengerated vs wind direction
Voltage
Current
Total Power
80.00
60.00
40.00
20.00
0.00
High Power
No Power
90 degrees
85 degrees
80 degrees
75 degrees
70 degrees
65 degrees
60 degrees
55 degrees
50 degrees
40 degrees
30 degrees
20 degrees
10 degrees

Data Table

Angle of wind	voltage Generated. Unit: Volt				current Generated. Unit: milliAmpere				Total Power = Voltage x Current Unit mili Watt
	Trial 1	Trial 2	Trial 3	Average	Trial 1	Trial 2	Trial 3	Average	
90 degrees	3.83	3.92	3.8	3.85	16.1	16.6	16.8	16.50	63.53
85 degrees	3.76	3.71	3.79	3.75	15.5	14.1	15.3	14.97	56.17
80 degrees	3.6	3.58	3.56	3.58	14.8	13.8	14.5	14.37	51.43
75 degrees	3.3	3.39	3.35	3.35	13.5	12.7	12.2	12.80	42.84
70 degrees	2.81	2.89	2.95	2.88	11.6	12.8	12.2	12.20	35.18
65 degrees	2.56	2.63	2.67	2.62	7.9	7.7	8.2	7.93	20.79
60 degrees	2.32	2.27	2.22	2.27	4.2	5.1	4	4.43	10.06
55 degrees	1.82	1.78	1.8	1.80	2	2.18	2.01	2.06	3.71
50 degrees	1.5	1.45	1.7	1.55	0	0	0	0.00	0.00
40 degrees	0.61	0.7	0.69	0.67	0	0	0	0.00	0.00
30 degrees	0	0	0	0.00	0	0	0	0.00	0.00
20 degrees	0	0	0	0.00	0	0	0	0.00	0.00
10 degrees	0	0	0	0.00	0	0	0	0.00	0.00

Conclusion

In conclusion my prediction was wrong. 90^{o} - 75^{o} had the most power generated. 39^{o} - 0^{o} had no power generated. If you were to put a wind turbine outside make sure to put it 90^{o} - 75^{o} facing the wind to get the most power. Also design the wind turbines base so that it can be rotated to be aligned perpendicular to the wind when the wind direction changes. My experiment is helpful as many companies can design wind turbines that can be rotated 360^{o} and connected to the computer, so based on weather, the computer can align the turbine to the wind to get better efficiency.


Thank You!
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